

ALPS Erosion/Redeposition Activities

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- Analysis of DIII-D/DiMES 2/01 Lithium Experiments

Non-disruption shots: being analyzed via coupled plasma fluid and impurity transport codes (ALPS/APEX plasma modeling group). Initial results show ballpark match with expected sputtering coefficients, sputtered Li transport.

Disruption shot: Sheath superheat scenario being analyzed via coupled BPHI-3D/THERM code. Other scenarios (self-sputter runaway, MHD, etc.) being analyzed.

- Analysis of liquid tin divertor

Tin divertor system being analyzed as complement to Sn APEX liquid wall application. Erosion/redep. analysis performed for ARIES-AT tokamak design. Results look good.

DIID-D/DiMES Lithium Erosion Experiment Preliminary Erosion/Redeposition Analysis

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REDEP/WBC code Simulation of DiMES Lithium Experiment, shot #105508 (2/13/01)

*Using (1-D) measured plasma parameters/profiles**

Li atoms sputtered from 1 inch diameter spot

VFTRIM-3D/RCC sputter distribution, ADAS rate coefficients

[10,000 particles launched per simulation]

Parameter	Strike point = center of DiMES	Strike point = 5 cm inboard of DiMES
Plasma density, Ne	$2.8 \times 10^{19-3} \text{ m}^{-3}$	$2.9 \times 10^{18-3} \text{ m}^{-3}$
Plasma temperature, Te	40 eV	8 eV
Mean-free-path for sputtered atom ionization (perp. to surface)	1.8 mm	47 mm***
Charge state**	1.004	1.000
Angle of incidence** (from normal)	32 °	47 °
Energy**	95 eV	26 eV
Redeposition fraction on 2.54 cm diameter lithium spot	0.68	0.06
Redeposition fraction on 5 cm diameter DiMES probe	0.82	0.10
Fraction of sputtered lithium escaping the near-surface region (0-5 cm from plate)	0.015	0.19

* D.G. Whyte, preliminary memo 2/20/01

**average value for redeposited ions

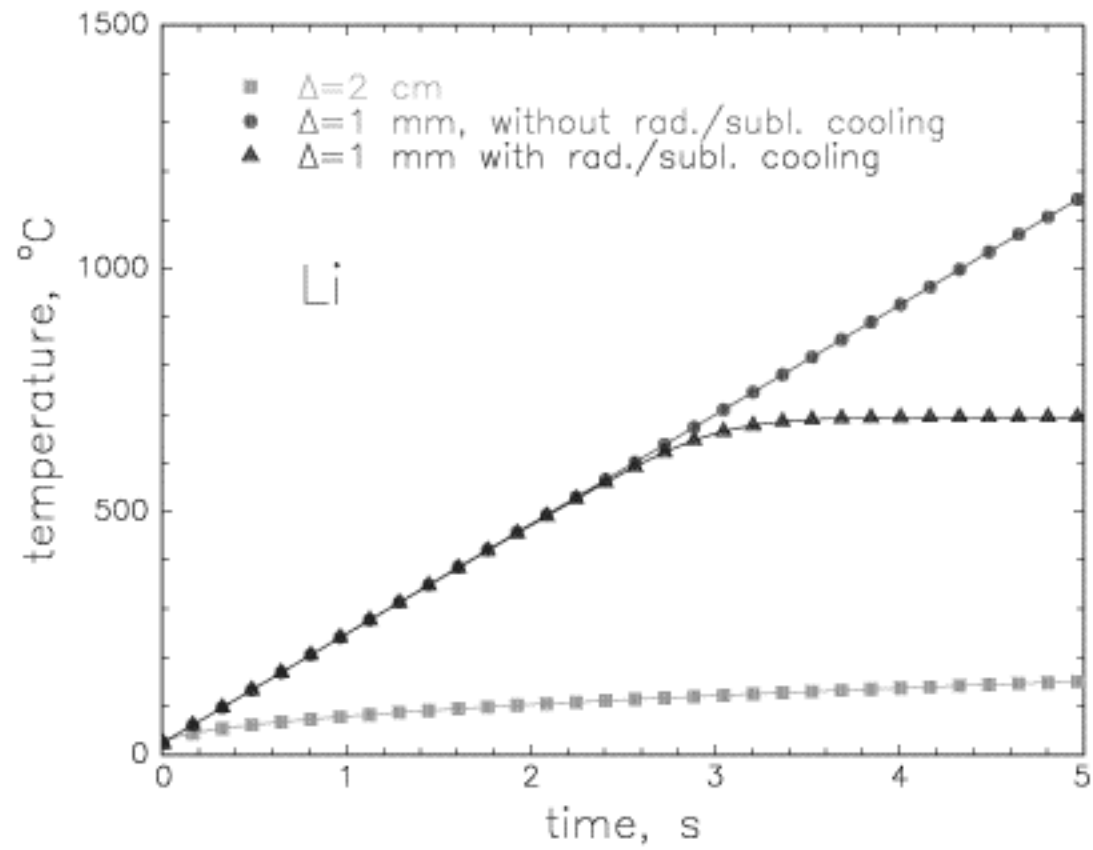
*** includes ionization events well outside of near-surface region, needs plasma-model refinement.

Parameter	Strike point = 1 cm inboard of DiMES	Strike point = 3 cm inboard of DiMES
Plasma density, Ne	$1.5 \times 10^{19} \text{ m}^{-3}$	$4.7 \times 10^{18} \text{ m}^{-3}$
Plasma temperature, Te	24 eV	10 eV
Mean-free-path for sputtered atom ionization (perp. to surface)	3.8 mm	22 mm
Charge state**	1.003	1.000
Angle of incidence** (from normal)	35 °	45 °
Energy**	86 eV	36 eV
Redeposition fraction on 2.54 cm diameter lithium spot	0.56	0.156
Redeposition fraction on 5 cm diameter DiMES probe	0.72	0.27
Fraction of sputtered lithium escaping the near-surface region (0-5 cm from plate)	0.025	0.077

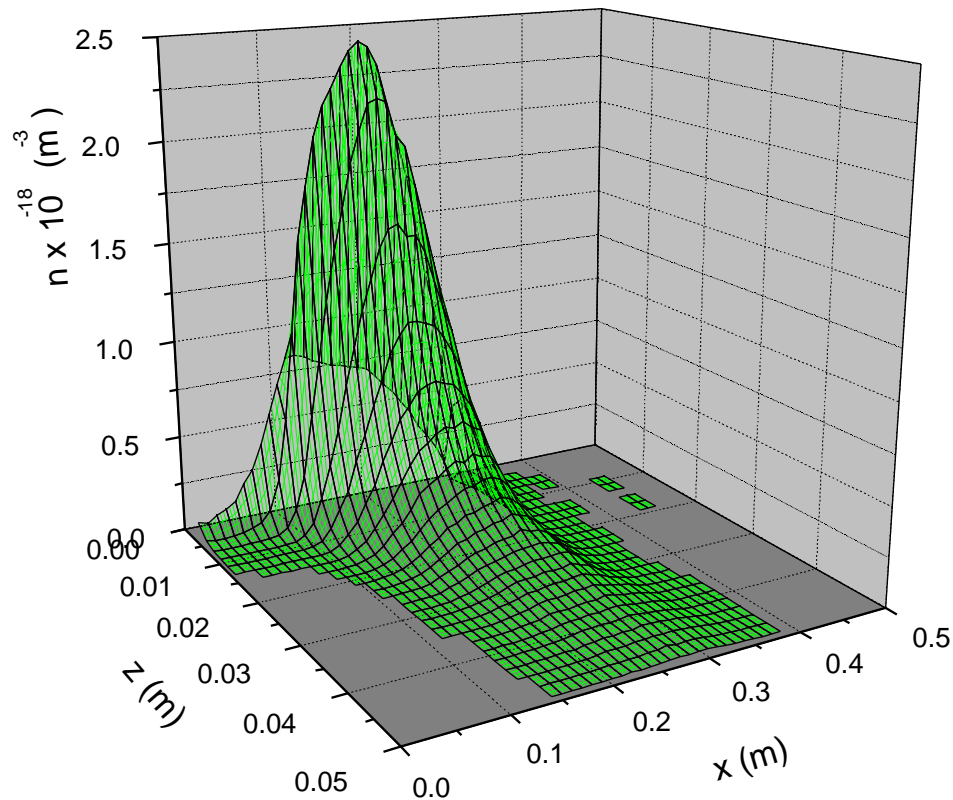
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**average value for redeposited ions

D. Naujoks DiMES Lithium THERM code analysis, 0.5 MW/m², fixed sheath. Lithium surface temp. as a function of time.



WBC Monte Carlo code analysis of liquid tin
divertor erosion/redeposition. Sputtered tin ion
density in the near-surface region.



(Divertor surface at $z = 0$ along poloidal direction “x”). Analysis uses UEDGE near-surface, high-recycle plasma conditions (T. Ronglien) for ARIES-AT tokamak design. Sputtering coefficients from VFTRIM (self-sputt., Ruzic et al.), TRIMSP (D-T sputtering, Bastasz). 10^6 particle histories.

- **Low plasma contamination: Peak Sn density is $\sim 2.5 \times 10^{18} \text{ m}^{-3}$. (Peak D-T density $\sim 2.5 \times 10^{21} \text{ m}^{-3}$)**
- **Sn density falls to ~ 0 within 5 cm of the plate.**